REMARKS

This is in response to the Official Action currently outstanding with regard to the above-captioned case.

Claims 1-47 were pending prior to the Examiner's Requirement for Restriction of 10 April 2001. As a result of Applicants' response to that Requirement for Restriction, Claims 15-28, 30 and 38-47 were withdrawn from further consideration in this application, without prejudice. Claims 1-14, 29 and 31-37, therefore, constitute the claims to which the present Official Action is directed. By the foregoing Amendment, Claims 2, 9 and 12 have been canceled, without prejudice. Claims 1, 3, 6, 10, 13, 14, 29 and 31 have been amended. Further, New Claim 48 has been added. Accordingly, upon the entry of the foregoing Amendment, Claims 1, 3-11, 13-14, 29, 31-37 and 48 will constitute the claims pending under active prosecution in this application.

Pursuant to the Rules, a "**VERSION SHOWING CHANGES MADE TO THE CLAIMS**" is attached hereto.

In the currently outstanding Official Action, the Examiner has:

1. Acknowledged Applicants' claim for foreign priority under 35 USC 119(a)-(d) and also acknowledged the receipt of the required certified copy of the priority documentation by the United States Patent and Trademark Office.

2. Provided Applicants with a copy of a Notice of References Cited (Form PTO-892) and copies of each of the references cited therein.

3. Rejected Claims 1-14, 29 and 31-37 under 35 USC 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

4. Rejected Claims 1-14, 29 and 31 –37 under 35 USC 103(a) as being unpatentable over the Mori et al reference (US Patent 5,559,618) in view of the Wu SID '95 article previously cited, the Wu Materials, Chemicals and Physics article presently cited, the Bosma et al reference (US Patent 5,760,859), the Nishimura et al article previously cited, and the Herke article presently cited.

No further comment regarding items 1 and 2 above is deemed to be required in these Remarks.

With respect to item 3, the Examiner alleges that the dispersion levels currently claimed are the same as those conventionally employed by the prior art as shown by the Bosma et al reference and both of the cited Wu references. Accordingly, the Examiner argues that either the prior art inherently achieved the claimed result of no viewing angle dependent coloration occurring on the liquid crystal display element, or the current specification is not enabling. **Applicants respectfully totally disagree with the Examiner's conclusion in this regard for the reasons set forth hereinbelow.**

At the outset of his argument, the Examiner alleges that the wording of the claims to the effect that "*the refractive index anisotropy is specified to vary with wavelengths of rays of light within a range that allows no viewing angle dependent coloration to occur on a displayed image (as claimed on an image displayed on the liquid crystal display element)*" can be interpreted in the context of this application in several ways. In particular, the Examiner suggests that the wording italicized above might mean (1) the particular refractive indexes disclosed in the specification and set forth in various of the dependent claims as causing the claimed function; (2) any way of using any device to achieve the goal of no viewing angle coloration utilizing only a compensator and an index; or (3) any means wherein dispersion is present and the desired end result is achieved.

Thereafter, the Examiner assumes that the second of his proposed alternatives is intended, substitutes the values of dispersion allegedly disclosed by Wu, and deduces that devices such as that disclosed by Mori et al inherently achieve the desired result when the known dispersion values of the LCD material are utilized therein. Further, the Examiner argues that the Wu teaching of LCD/compensator matching constitutes another way of achieving the same result. Still further, the Examiner suggests that if the claimed result is not the same as the combinations of the prior art that he has suggested, then the specification of this application is not enabling because it does not teach anything other than that taught by the prior art to which he has referred. In addition, the Examiner suggests that even if the claims are considered to be appropriately enabled by the specification, they are too broad because (a) there is no specific teaching as to how to make the claimed LCD, and (b) even if the LCD itself is adequately taught, there are many known ways to form an LCD, such as multidomain, collimation, etc., that broadly fall within the terms of the claims but are not taught in the specification.

It is respectfully submitted that the foregoing positions taken by and arguments set forth by the Examiner in the above regards are not adequately supported in the context of this application.

One basic reason for this is submitted to be that the Examiner's artificial creation of alternative ways of interpreting the above-italicized phraseology, and then selecting a one of those alternatives that does not follow the clear wording of the claims is simply a "bootstrap" approach that cannot withstand analysis. Accordingly, it will be recognized that the claims do not speak in terms of the compensator and the index determining the nature of the liquid crystal display element, nor do they speak in terms of any means of achieving no viewing angle coloration of an image formed by the liquid crystal display device *per se*. Rather, the claims speak in terms of either (1) *the liquid crystal material* being such that the refractive index anisotropy is specified to vary with wavelengths of rays of light within a range that allows no viewing-angle dependent coloration to occur to an image displayed *on the liquid crystal display element*, or (2) the difference of the refractive index anisotropy *of the liquid crystal* for rays of light having a wavelength of 450 nm and the refractive index anisotropy *of the liquid crystal* for rays of light having a wavelength of 650 nm being set within a definite range, and/or (3) the wavelength dependent Δn (550) of the *liquid crystal material* being set within a certain range.

In this regard also it is to be recalled that in response to the third Official Action in this case, Applicants argued that the present invention adopts the adjustment of wavelength dispersion of liquid crystal molecules as a means for solving the problem of undesirable coloring of display images on the liquid crystal element that develop due to the color going out of balance when the display is viewed at an oblique angle. Hence, the present invention is distinct from the cited references taken either alone or in combination because in the present invention the wavelength dispersion of the liquid crystal material does not coincide with that of the phase difference plate as suggested for instance by the Wu references.

Further, it also is to be recalled that the present invention teaches that the provision of a phase difference plate alone is not sufficient for restraining the viewing-angle dependence problem. Rather, it is necessary to vary the anisotropy of the refractive index anisotropy of the liquid crystal material so as to control the wavelength dispersion caused by the molecules thereof. Still further, one must remember that one of the characteristics of the present invention is to optimize the range of the refractive index anisotropy of the liquid crystal materials to prevent coloration the display images they produce, thereby making it unnecessary to take the wavelength dispersion of the compensator into account. To this end, the parameters of the liquid crystal materials were specified in the dependent claims as originally filed, and those parameters now have been at least partially added to the independent claims by the foregoing amendment so as to make more clear and definite the subject matter that was heretofore inherent therein.

Accordingly, Applicants respectfully submit that the Examiner has set up a sort of "straw-man" from which he has created an argument under 35 USC 112. It is respectfully submitted, however, that once the foundation of that argument falls so does the remainder thereof. Such is submitted to be the result of the foregoing discussion.

Still further, it is not believed that the Examiner is seriously suggesting that those skilled in the art were incapable of making an liquid crystal display materials for the liquid crystal layer claimed wherein the refractive index anisotropies at various wavelengths of light could be set to desired values at the time the present invention was made. The examples of the present specification discuss doing so, and no question has been raised during over four years of United States prosecution of this application to suggest otherwise. Similarly, a construction of the claims at this late date so as to artificially expand their scope beyond the fair meaning of the associated specification is not believed to be appropriate.

Finally, it is respectfully suggested that the Examiner has misinterpreted the scope of the disclosure in the references. Thus, for example, it is to be noted that in Wu the birefringence of STN mixtures is stated to normally be in the range from 0.15 to 0.20, and for TN mixtures in the range from 0.08 to 0.10. The wavelength-dependent birefringence, however, at a wavelength of 589nm for ZLI-1565 is stated to be 0.13, and for E-63 to be 0.22. Hence, since the claims are discussing wavelength-dependent values, and the disclosed wavelength dependent values are outside of the normal range for either STN or TN type LCD materials, it is not seen how the Examiner can justify a statement that the ranges disclosed in the art are the same as those herein claimed based upon these statements in the references.

Further, Wu refers to a wavelength dependent birefringence of ZLI-2857 at 632.8 nm as being 0.072 (the difference between n_e and n_o). Neither Wu nor Bosma et al, however, clearly disclose wavelength dependent birefringence values of the latter material at any other wavelength. Hence, it is assumed from the Examiner's reference to so-called dispersion charts, that the Examiner has attempted to extrapolate birefringence values mathematically therefrom.

If this indeed is the basis of the Examiner's allegations that the material of the liquid crystal display element of the present invention is a material commonly in use in the prior art, Applicant respectfully submit that such an imperfect recreation of the supporting data from the charts is notoriously unreliable. In addition, even if one accepts for purposes of argument only that the Examiner's conclusion that the dispersion charts disclose materials in prior use having a wavelength dependent birefringence at 550 nm within the ranges herein specified, this fact alone does not show the use of the claimed materials in common use in the prior art. For example, Applicants' mathematical extrapolations from the same charts as those apparently utilized by the Examiner indicate that the Δn (450) – Δn (650) of the graphed material parameters do no fall within the ranges herein claimed.

The conclusion, therefore, is submitted to be inescapable that the Examiner has failed to show the materials claimed for the liquid crystal layer of this invention in common use for a similar purpose in the prior art. Certainly, a mathematically derived value for Δn (550) based upon notoriously questionable variable values derived from an unclear graph is insufficient to support the Examiner's current position. The definitive nature of the alleged disclosure is totally lacking, and even if the result is accurate, it disregards the other pervasive limitations of the claims. In view of the foregoing discussion, Applicants must respectfully submit that the Examiner's rejection of the claims under 35 USC 112 cannot stand, and should be withdrawn. A decision so holding in response to this communication is respectfully requested.

With respect to item 4, Applicants respectfully submit that the Examiner has made the same mistake in analysis as he made with respect to his rejections under 35 USC 112 discussed above. Specifically, the Examiner alleges that the newly cited Mori et al reference discloses a liquid crystal display device with a compensator having nx > nz > ny and nz inclined, but does not discuss *the dispersion of the refractive index and that the result of the matching is that the compensation achieves the result claimed.* From this, the Examiner argues that all the claimed structure is present in the prior art and only the function claimed is missing, thereby shifting the burden of proof of nonobviousness to the Applicants. It is clear, therefore, that the Examiner is still reading the claims as being directed to any way of using the device to achieve the goal taught using *only the compensator and the index.* As discussed above, however, the claims in fact are directed to *the setting of the refractive index anisotropy of the liquid crystal material layer such that no undesired coloration appears on its surface.*

More specifically, one of the characteristics of the present invention is to optimize the range of the refractive index anisotropy Δn *of the liquid crystal materials* to prevent coloration of display images thereon so as to thereby make it totally unnecessary to take the wavelength dispersion of the compensator into account. Stated slightly differently, the parameters disclosed by Wu, Bosma et al and others of the so-called secondary references are specified for the sake of equalizing the wavelength dispersion of the liquid crystal materials and the wavelength dispersion of the phase difference plate. In contrast, the parameters set forth in the present application are specified for the sake of limiting the wavelength dispersion of the liquid crystal materials to an optimum range in order to avoid the coloring of display images. Hence, the Examiner's apparent belief that the present invention is directed to compensator/liquid crystal material refractive index anisotropy "matching" (as that term is used by Wu) is in error. Similarly, the Examiner's assertion that the wavelength dispersion values and the relationships among them as herein claimed are simply the values taught by the prior art is respectfully submitted to be in error, or at least not definitively supported, as well.

As was alluded to in response to a previous Official Action in this application, it is to be understood that a liquid crystal display device develops undesirable coloring of display images due to variations in the lengths of the optical paths through the phase difference plate and liquid crystal layer when the display is viewed from an oblique angle. This is also the case due to color going out of balance because of irregularities in the apparent optical axes (slow axis and fast axis) of the phase difference plate and liquid crystal layer when the display is viewed from an oblique angle.

The present invention relates to a technology that solves these phenomena by means of adjustment of the wavelength dispersion of liquid crystal molecules, even in those cases wherein the liquid crystal molecules are moved by voltage application. It is believed that the present invention is distinct over each of the cited references, and any combination thereof, because in the present invention the wavelength dispersion of the liquid crystal material layer does not coincide with that of the phase difference plate.

The Wu references disclose biaxial compensation films that are polyimide films fabricated, by spin coating, of polycarbonate that is developed to extend the ranges of the viewing angle and the wavelength. Unlike the phase difference plate of the present invention, however, the compensation film of the Wu reference is not defined in terms of the relationship among its principal refractive indices n_a, n_b, and n_c. Further, although the Wu reference discloses ZLI-2857 available from MERCK being used as the liquid crystal material, that liquid crystal material also does not have optical properties of the liquid crystal material used in the present invention. This is respectfully submitted to be the case despite the Examiner's mathematical extrapolations from the dispersion chart shown in the Wu references. Note in this regard Applicants' comment above to the effect that an extrapolation believed to be similar to that relied upon by the Examiner fails to support a showing of Δn (450) – Δ (650) falling within the range herein claimed for that material.

In addition, the Wu reference also discloses the liquid crystal and the phase difference plate being stacked so that their wavelength dispersions overlap. In contrast, the present invention discloses the liquid crystal being adjusted in its wavelength dispersion to keep the color in good balance in the front direction when the display is viewed from an oblique angle. This is clearly not the same as the liquid crystal and the phase difference plate being stacked so that their wavelength dispersions overlap.

The Examiner nevertheless continues to assert that the Wu disclosure of the ZLI-2857 material as a material commonly used as the liquid crystal layer constitutes a disclosure of a material that would fall within the terms of the claims of this application. Specifically, the Examiner suggests that Wu discloses liquid crystal materials having birefringence values of 0.074 and 0.1, and also states the ZLI-2857 has a Δn of 0.072 at 627 angstroms and dispersion values of 0.080 at 550nm and 0.092 at 450nm apparently as mathematically extrapolated from the dispersion chart shown therein. The Examiner further asserts that similar showings are contained in the Bosmna et al dispersion chart (presumably meaning Bosma et al, Fig. 2).

Applicants have found reference in Wu to birefringence values for STN materials as being typically in the range from 0.15 to 0.20, and for TN materials in the range from 0.08 to 0.10, but otherwise have not been able to locate any statement of the birefringence values referred to by the Examiner in the Wu references. Further, Applicants have noted reference in the Wu references to ZLI-1565 having a wavelength dependent Δn of 0.13 at a wavelength of 589 nm, to E-63 having a wavelength dependent Δn of 0.22 at a wavelength of 589 nm, and to ZLI-2857 having a wavelength dependent Δn of 0.072 at a wavelength of 632.8 nm. The other values quoted by the Examiner have not been found in the cited reference, however.

Consequently, Applicants assume that the Examiner has extrapolated the values he has quoted from the so-called dispersion charts of the references with all of the problems in so doing discussed above. In particular, the so-called dispersion charts of the Wu and Bosma et al references depict wavelength in nm in relation to wavelength dependent Δn normalized to wavelength Δn (550). There are no specific indications as to the values of the various points on the graphs shown, however, so any conversion of the data points depicted so as to provide an indication of the wavelength dependent Δn for an particular wavelength appears to be guesswork at best.

By the foregoing Amendment, Claims 2 has been canceled, without prejudice, and its limitations have been incorporated into Claim 1. The dependency of Claim 3 has been altered accordingly. Also, Claim 6 has been presented in independent form including the limitations of Claim 9, which along with redundant Claim 12, has been canceled, without prejudice. The dependencies of Claims 10-11 and 13-14 have been altered accordingly. Claim 29 has been amended for clarity and to incorporate limitations similar to those of Claim 6. Claim 31 has been amended for clarity and to specifically include the functional limitations concerning the nature of the liquid crystal material inherent to all of the pending claims. As noted above, the purpose of these Amendments is to make explicit that which was previously inherent in the claims as filed.

It also is respectfully submitted that these Amendments will remove any potential basis for the Examiner's failure to understand that the present invention is directed to the setting of the wavelength dependent Δn values of the liquid crystal layer material so as to avoid undesirable coloration on the surface thereof, rather than to refractive index anisotropy matching between the liquid crystal material and the compensator plate. The scope of the claims is not materially altered by this Amendment. The claims are interpreted in light of the specification, and the specification clearly indicates that in addition to the general functional requirement claimed, one or both of two specified conditions are useful in determining whether or not a particular liquid crystal material falls within the scope of the present invention. These two conditions are set forth clearly in the specification as follows:

> 1) "Δn (450) – Δn (650), i.e., the difference between the refractive index anisotropy Δn (450) of the liquid crystal material for rays of light having the wavelength of 450 nm and the refractive index anisotropy Δn (650) thereof for rays of light having the wavelength 650 nm, is set in a range not less than 0.0070 to not more than 0.0250. The difference is more preferably set in a range not less than 0.0200 to not more than 0,0250." (Page 26, lines 15 to22)
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> 2) "The refractive index anisotropy Δn (550) of the liquid crystal material for rays of light having the wavelength 550 nm is set to be larger than 0.060 and smaller than 0.120. More preferably, the refractive index anisotropy Δn (550) is set to be not less than 0.070 and not more than 0.095." (Page 28, Lines 4 to 9)

In view of the foregoing Amendment and Remarks, it is believed that all of the claims that will be present in this application upon the entry of the foregoing Amendment are in condition for allowance. Reconsideration and allowance of this application in response to this communication, therefore, is respectfully requested.

Applicants believe that additional fees are not required in connection with the consideration of this response to the currently outstanding Official Action. However, if for any reason a fee is required, a fee paid is inadequate or credit is owed for any excess fee paid, you are hereby authorized and requested to charge and/or credit Deposit Account No. **04-1105**, as necessary, for the correct payment of all fees which may be due in connection with the filing and consideration of this communication.

Respectfully submitted,

Date: August 16, 2002

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VERSION SHOWING CHANGES MADE TO THE CLAIMS

Additions shown underlined; Deletions shown in brackets.

Please cancel Claims 2 and 9, without prejudice.

Please amend Claims 1, 3, 6, 29 and 31 as follows:

1. (Thrice Amended) A liquid crystal display device, comprising:

a liquid crystal display element including:

a pair of substrates; and

a liquid crystal layer sandwiched by the substrates and constituted by a liquid crystal material of which the refractive index anisotropy is specified to vary with wavelengths of rays of light within a range that allows no viewing-angle dependent coloration to occur to an image displayed on the liquid crystal display element;

a pair of polarizers disposed so as to sandwich the liquid crystal display element; and

at least one phase difference plate disposed between the liquid crystal display element and the pair of polarizers,

wherein the phase difference plate has three principal refractive indices n_a, n_b, and n_c being mutually related by the inequality $n_a<n_b<n_c$, wherein the principal refractive index n_b inclines to the normal to a surface of the phase difference plate, and wherein the refractive index anisotropy Δn (550) of the liquid crystal material for rays of light having the wavelength of 550 nm is specified to be more than 0.060 and less than 0.120.

3. (Amended) The liquid crystal display device as defined in claim [2] 1, wherein the refractive index anisotropy Δn (550) is specified to be not less than 0.065 and not more than 0.115.

6. (Amended) A liquid crystal display device, comprising:

a liquid crystal display element including:

a pair of substrates; and

a liquid crystal layer sandwiched by the substrates and constituted by a liquid crystal material of which the refractive index anisotropy is specified to vary with wavelengths of rays of light within a range that allows no viewing-angle dependent coloration to occur to an image displayed on the liquid crystal display element;

a pair of polarizers disposed so as to sandwich the liquid crystal display element; and

at least one phase difference plate disposed between the liquid crystal display element and the pair of polarizers,

wherein the phase difference plate has three principal refractive indices n_a, n_b, and n_c being mutually related by the inequality $n_a<n_b<n_c$, wherein the principal refractive index n_b inclines to the normal to a surface of the phase difference plate, wherein the refractive index anisotropy Δn (550) of the liquid crystal material for rays of light having the wavelength of 550 nm is specified to be more than 0.060 and less than 0.120, and wherein Δn (450) - Δn (650), i.e., the difference between the refractive index anisotropy Δn (450) of the liquid crystal material for rays of light having a wavelength of 450 nm and the refractive index anisotropy Δn (650) thereof for rays of light having the wavelength of 650 nm, is specified to be not less than 0.0070 and not more than 0.0250.

10. (Amended) The liquid crystal display device as defined in claim [9] 6, wherein the refractive index anisotropy Δn (550) is specified to be not less than 0.065 and not more than 0.115.

13. (Amended) The liquid crystal display device as defined in claim [12] 6, wherein the optical phase difference plate includes:
a support base composed of a transparent organic high polymer; and
a liquid crystal polymer layer formed on the support base to be aligned to possess oblique orientation and crosslinked.

14. (Amended) the liquid crystal display device as defined in claim [12] 6, wherein the optical phase difference plate includes:

a support base composed of a transparent organic high polymer; and

a liquid crystal polymer layer formed on the support base to be aligned to posses hybrid orientation and crosslinked.

29. (Amended) A liquid crystal display device, comprising:

a liquid crystal display element including a liquid crystal layer sandwiched by a pair of light-transmitting substrates each having an electrode layer provided thereon;

a pair of polarizers disposed so as to sandwich the liquid crystal display element; and

at least one phase difference plate disposed between the liquid crystal display element and the pair of polarizers,

wherein the improvement comprises that the at least one phase difference plate has three principal refractive indices n_a, n_b, and n_c being mutually related by the inequality $n_a < n_b < n_c$, and the principal refractive index n_b inclines to the normal of a surface of [the] said at least one phase difference plate, and that the liquid crystal layer is constituted by a liquid crystal material wherein the refractive index anisotropy Δn (550) of the liquid crystal material for rays of light having the wavelength of 550 nm is specified to be more than 0.060 and less than 0.120, and wherein Δn (450) - Δn (650), i.e., the difference between the refractive index anisotropy Δn (450) of the liquid crystal material for rays of light having a wavelength of 450 nm and the refractive index anisotropy Δn (650) thereof for rays of light having the wavelength of 650 nm, is specified to be not less than 0.0070 and not more than 0.0250 such that [of which] the refractive index anisotropy thereof is specified to vary with wavelengths of rays of light within a range that allows no viewing-angle dependent coloration to occur on a displayed image

31. (Amended) A liquid crystal display device, comprising:

a liquid crystal display element including:

a pair of substrates; and

a liquid crystal layer sandwiched between the substrates constituted by a liquid crystal material of which the refractive index anisotropy is specified to vary with wavelengths of rays of light within a range that allows no viewing-angle dependent coloration to occur to an image displayed on the liquid crystal display element;

a pair of polarizers disposed so as to sandwich the liquid crystal display element; and

at least one phase difference plate disposed between the liquid crystal display element and the pair of polarizers,

wherein the at least one phase difference plate has three principal refractive indices n_a, n_b, and n_c being mutually related by the inequality $n_a < n_b < n_c$, and the principal refractive index n_b inclines to the normal of a surface of [the] said at least one phase difference plate, and

wherein Δn (450) - Δn (650), i.e., the difference between the refractive index anisotropy Δn (450) of the liquid crystal material for rays of light having a wavelength of 450 nm and the refractive index anisotropy Δn (650) thereof for rays of light having the wavelength of 650 nm, is specified to be not less than 0.0070 and not more than 0.0250.

Please add New Claim 48 as follows:

48. (New Claim) The liquid crystal display as defined in claim 31,

wherein the inclination angle of the principal refractive index n_b of the phase difference plate is specified to be in the range from 15° to 75°.